

Grassfed in the Desert Southwest: Ruminant Nutrition Fundamentals



Clint Löest

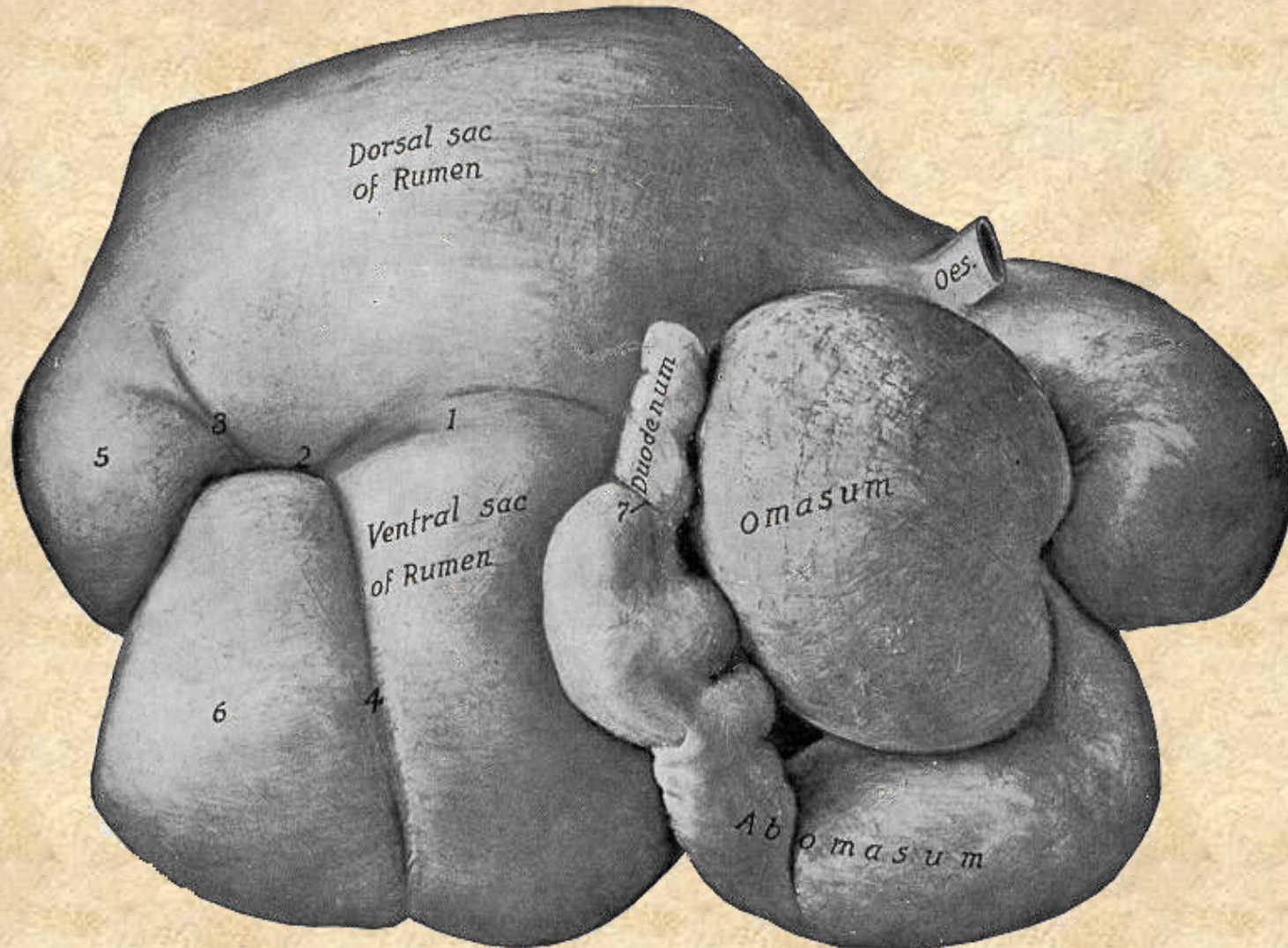
Associate Professor

Ruminant Nutrition

Outline

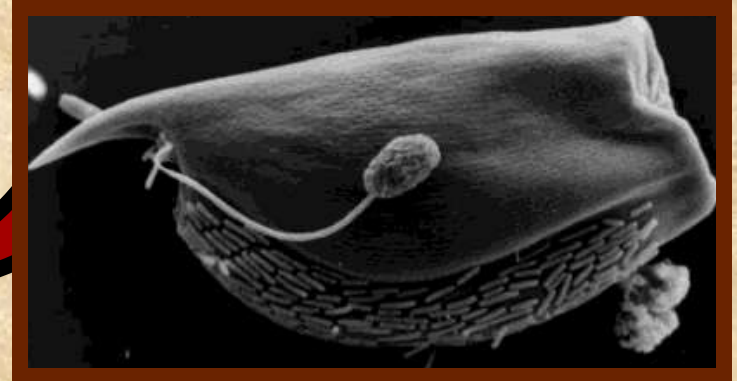
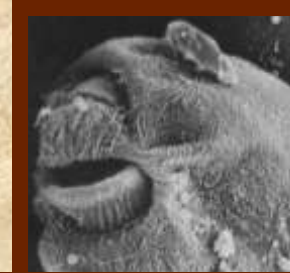
- **Understanding Rumen Function**
 - **Factors Affecting Rumen Function**
- **Nutrition**
 - **Energy utilization**
 - **Protein utilization**
- **Summary**
- **Conclusions**

Ruminant Stomach



Rumen Function

- Symbiotic relationship between:
 - Host (rumen of cattle)
 - Microorganisms



Rumen Function

- Host (rumen) provides microbes with a favorable environment:
 - Anaerobic (O_2 -free)
 - Constant temperature
 - Favorable pH?
 - Nutrients
 - Waste removal



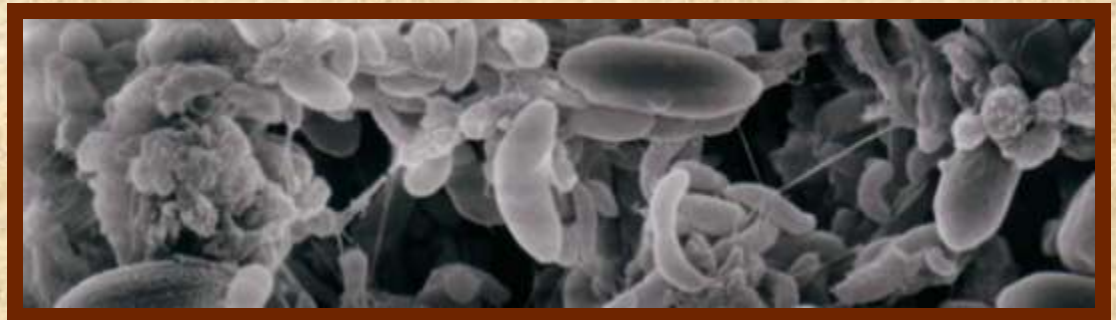
Rumen Function

- **Microorganisms provide host with ability to utilize forages:**
 - **Fiber-digesting capability**
 - **To harvest the energy in forages**
 - **Microbial Protein**
 - **Vitamins**



Rumen Microorganisms

- **Microbial activity ultimately determines nutrient availability**
- **Microbial population is dynamic:**
 - **Sensitive to changes in rumen environment**
 - **Those that predominate have adapted best**



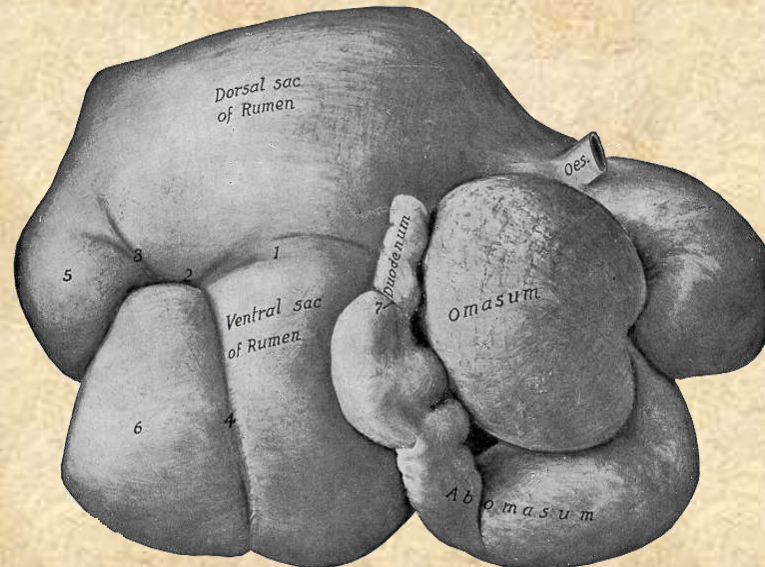
Rumen Microorganisms

- Divided broadly into 2 groups:
 - Fiber digesting bacteria
 - Active at $\text{pH} > 6$
 - Starch digesting bacteria
 - Active at $\text{pH} > 5$



Relevance?

- Any factor that affects rumen function will affect nutrient utilization and production



Nutrients in Feedstuffs

- **Have a major impact on:**
 - **Rumen function**
 - **Ability of cattle to utilize nutrients from other feeds**
- **Associative effects of feeds**
 - **Positive or negative**



Nutrition

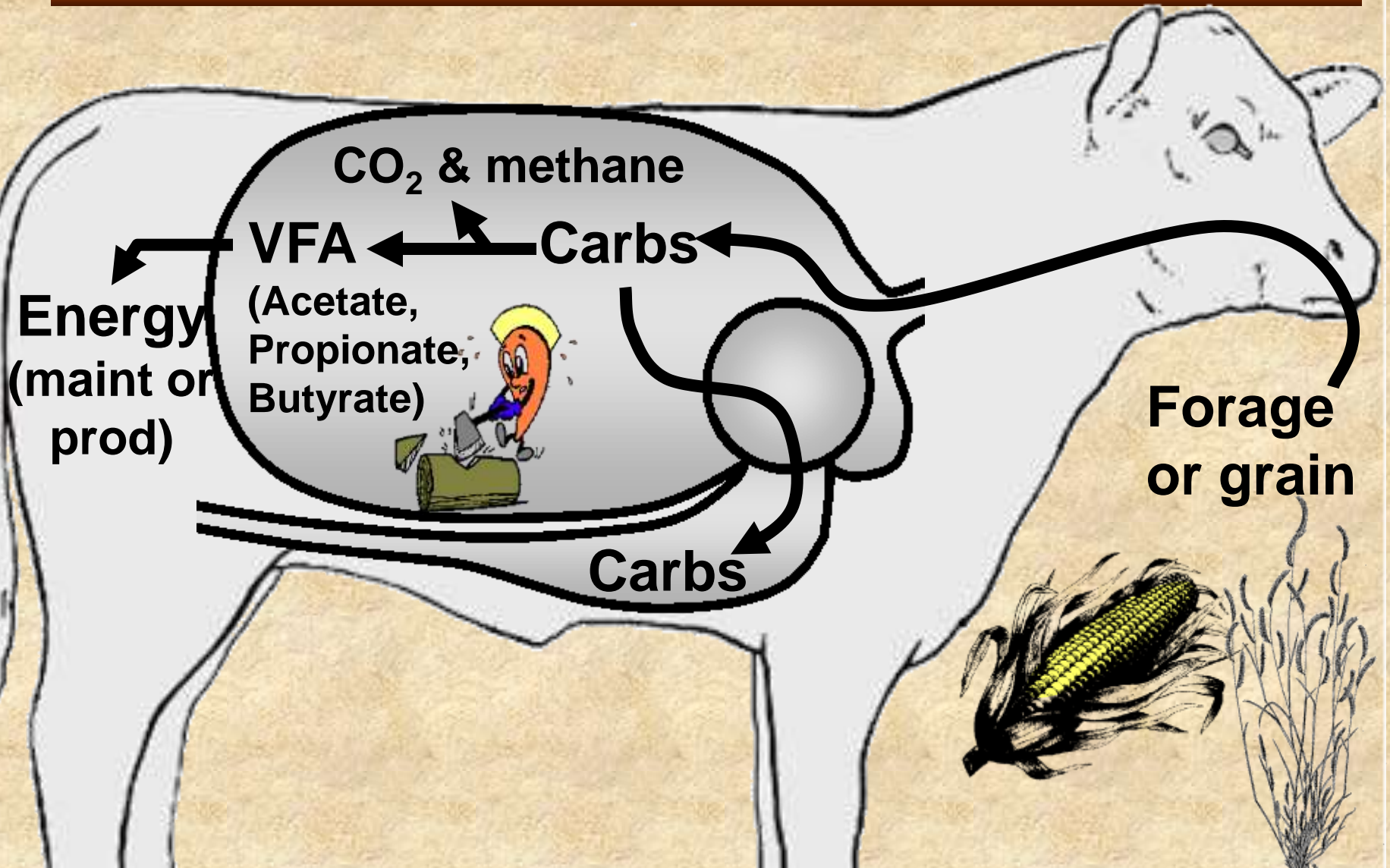
- **Good nutritional management:**
 - **Identify limiting nutrients**
- **Decision:**
 - **Accept limitation?**
 - **Correct limitation?**



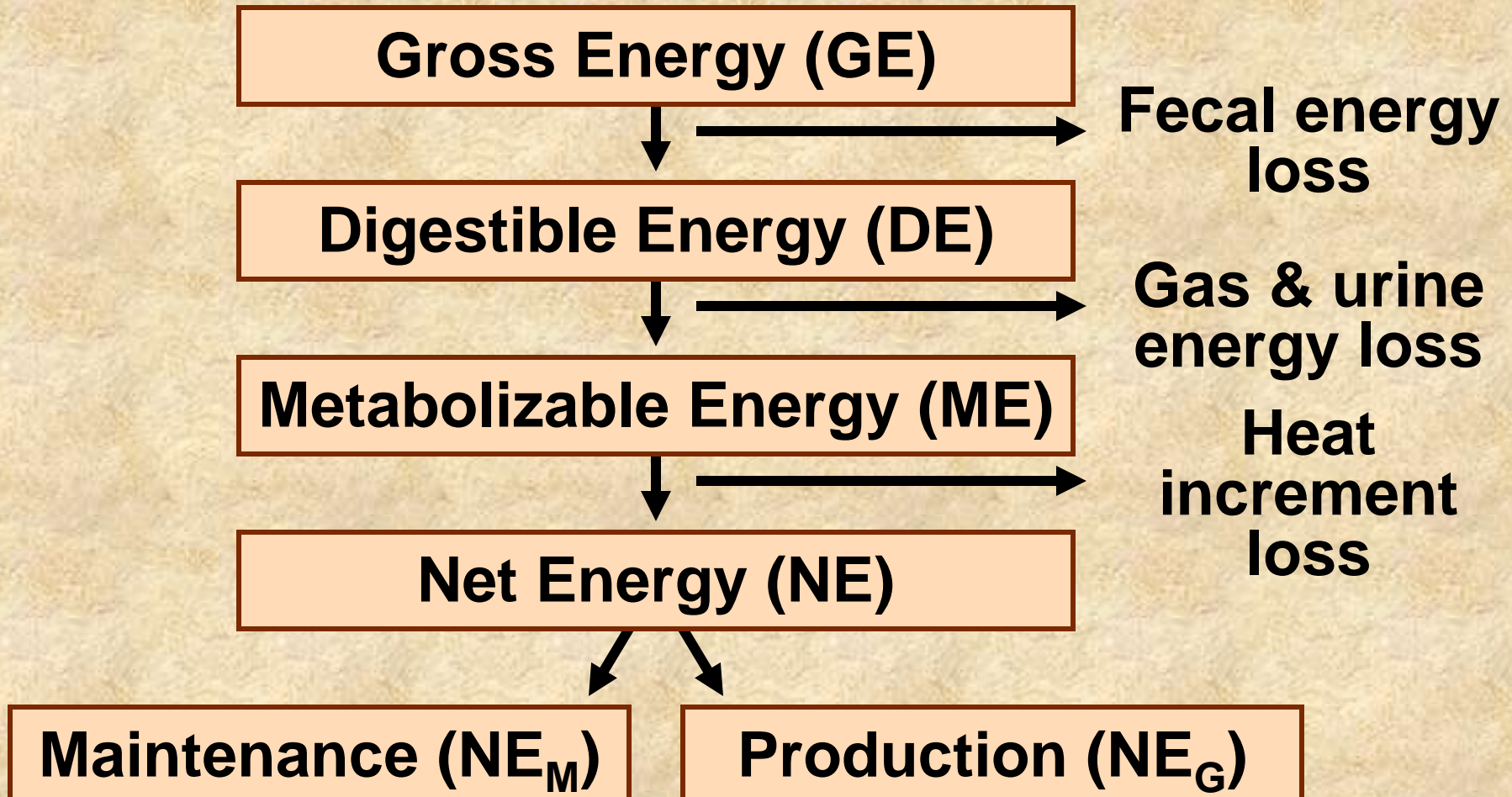
Energy

- **Energy supply drives production**
- **Potential nutrients for energy:**
 - **Carbohydrates**
 - **Ruminants harvest energy from structural carbs (fiber) in forages**
 - **Fats & Proteins**
- **Not all the energy consumed by the grazing animal is converted to product**

Carbohydrate Digestion



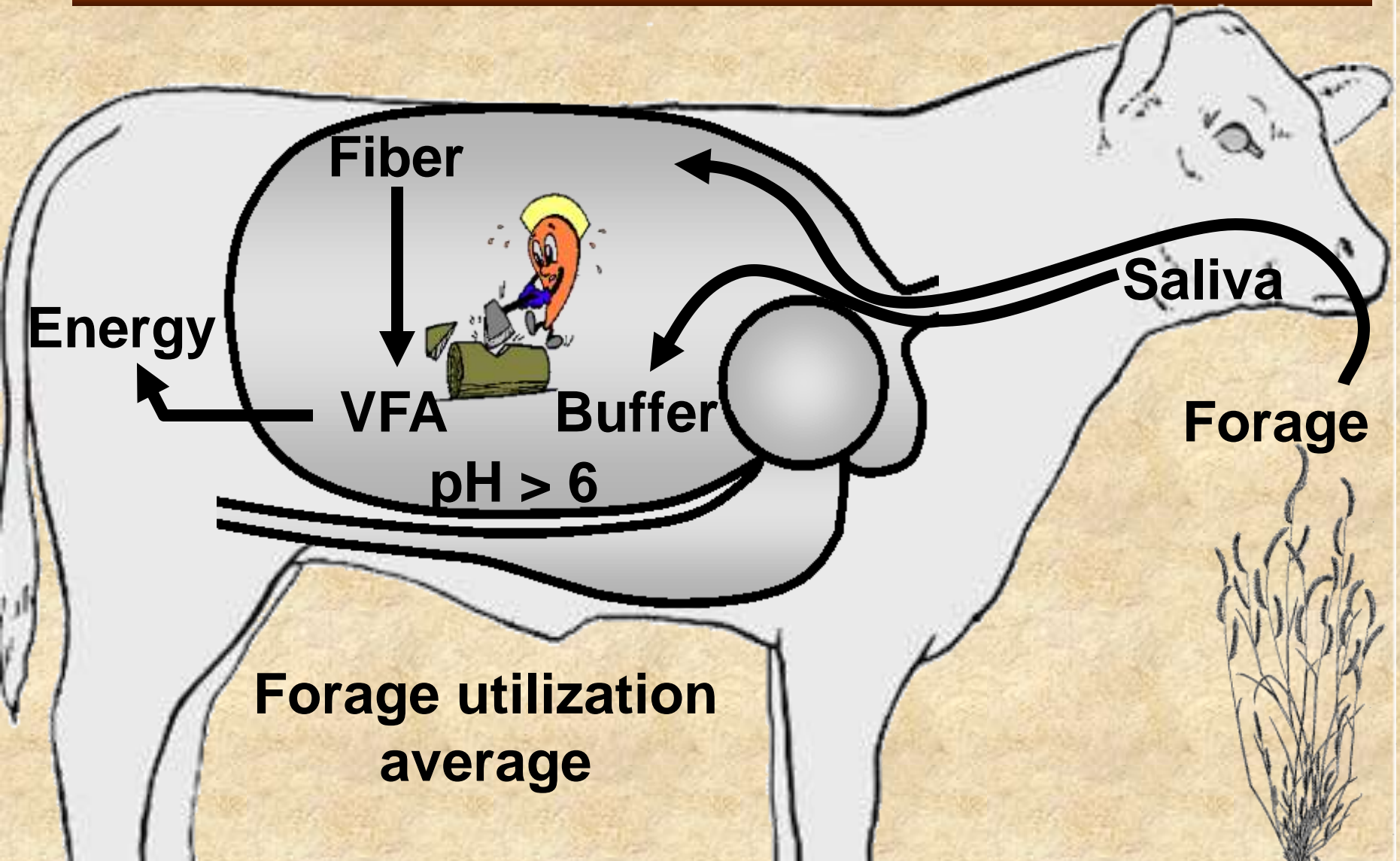
Partitioning of Energy



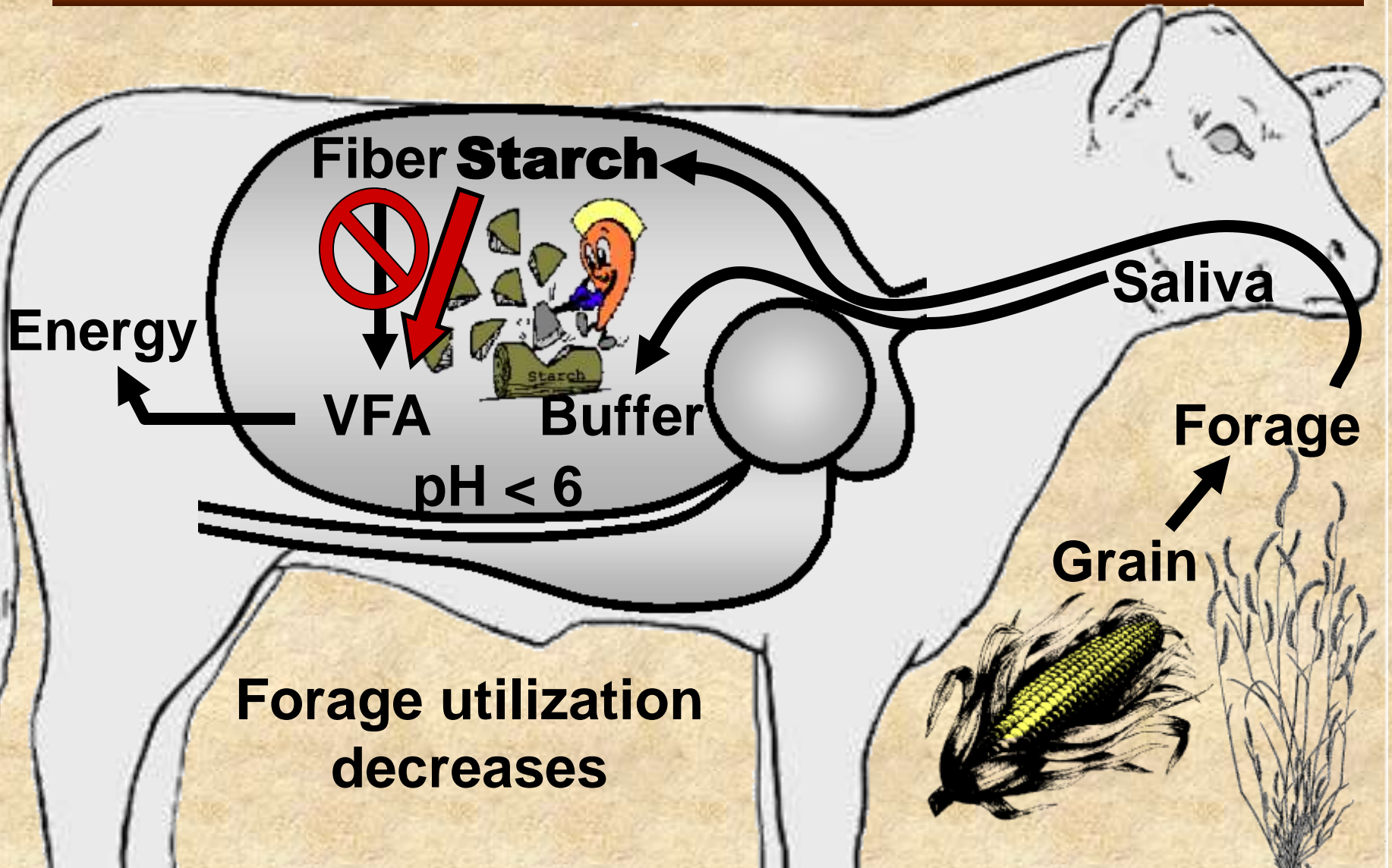
Net Energy for Production

- **To increase net energy for production:**
 - **Increase feed energy intake**
 - **Forage quantity and availability**
 - **Forage quality**
 - **Supplementation (energy, protein)**
 - **Decrease energy losses:**
 - **Feces, gas, urine, heat**

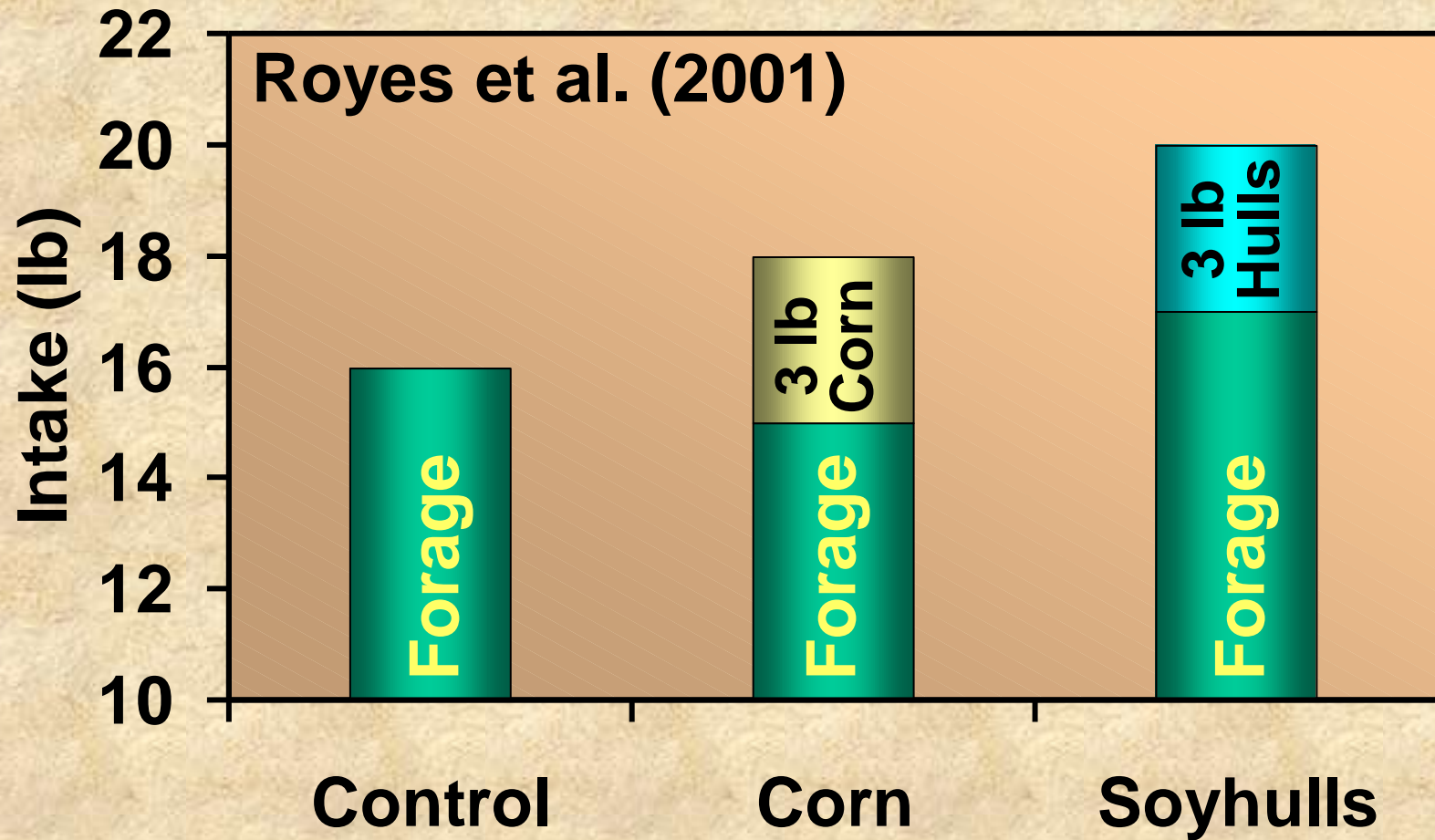
Forage-based Diet



Grain for Forage Diets

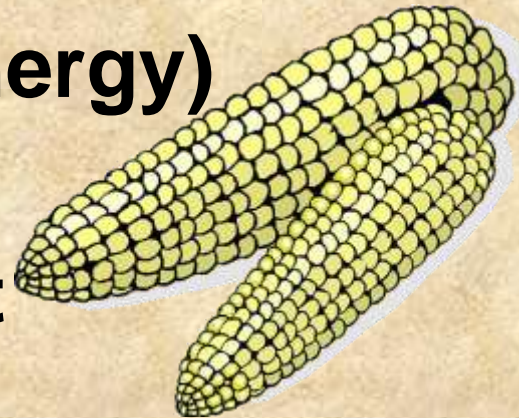


Energy Source



Forage-based Diets

- **Supplementing grain (starch):**
 - **Increases VFA (acid) production**
 - **Rumen pH < 6**
 - **Fiber-digesters are less active**
 - **Decreases:**
 - **Forage digestibility (energy)**
 - **Forage intake**
 - **Negative Associative Effect**
 - **“Substitution effect”**



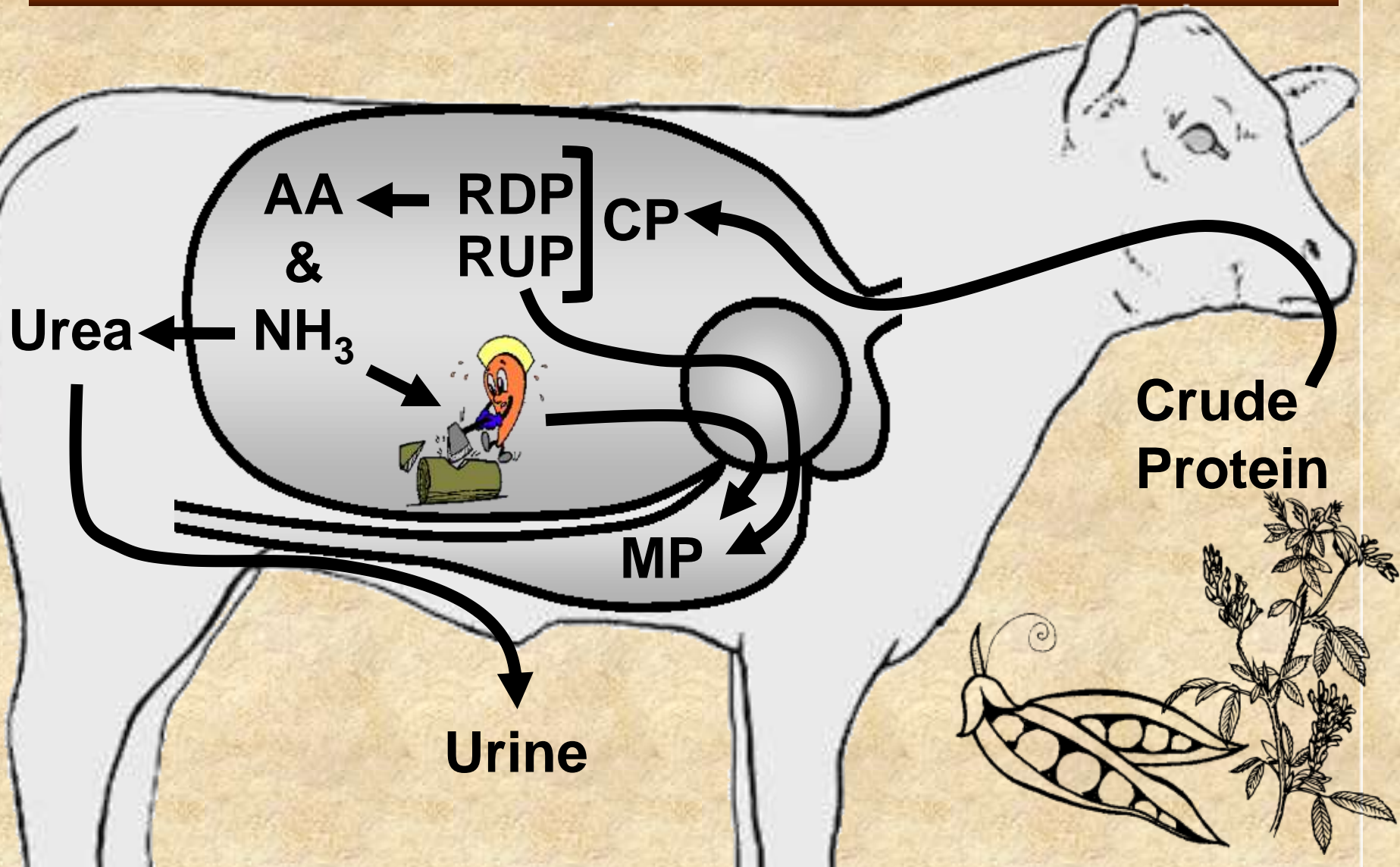
Forage-based Diets

- **Supplementing digestible fiber:**
 - **Increases energy without negatively affecting rumen pH**
 - **Activity of fiber-digesters not affected or increases**
 - **Does not affect or increases:**
 - **Forage digestibility (energy)**
 - **Forage intake**
 - **Positive Associative Effect**

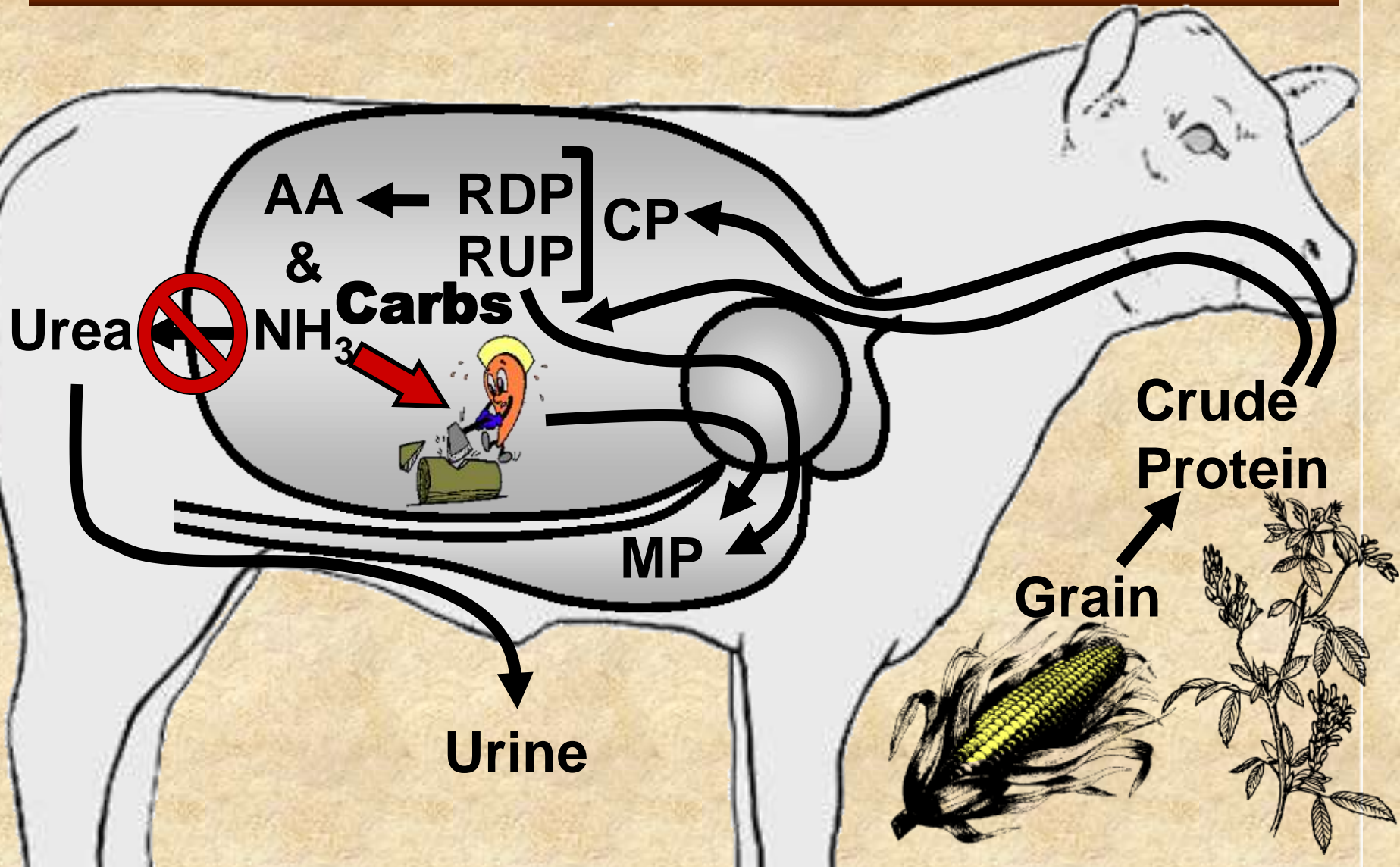
Protein

- **There are 2 types of protein**
 - **Ruminally degradable protein:**
 - **Needed to meet microbial needs**
 - **Ruminally undegradable protein:**
 - **Compliments microbial protein to meet productive needs of the animal**

Protein Digestion

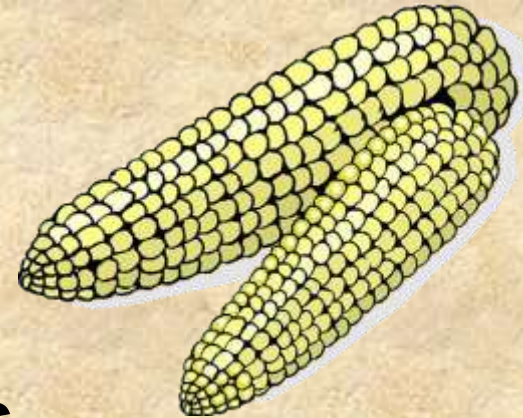


Carb for Forage Diets

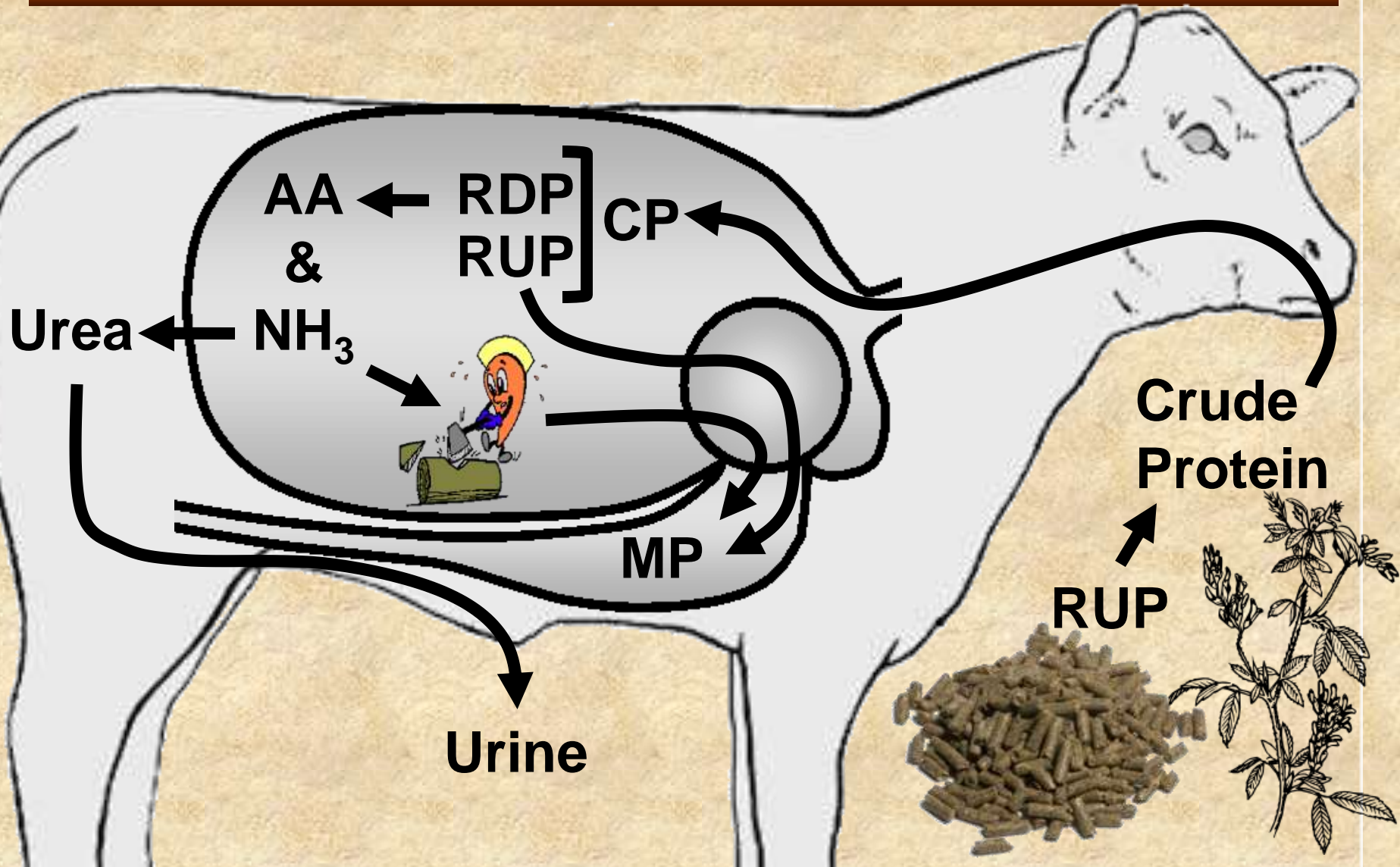


High Quality Forage Diets

- Forages with excess protein (RDP)
- Supplementing carbohydrates (energy):
 - Increase:
 - NH_3 use by microbes
 - Decreases:
 - Urea loss in urine
 - Protein utilization improves
 - Positive Associative Effect



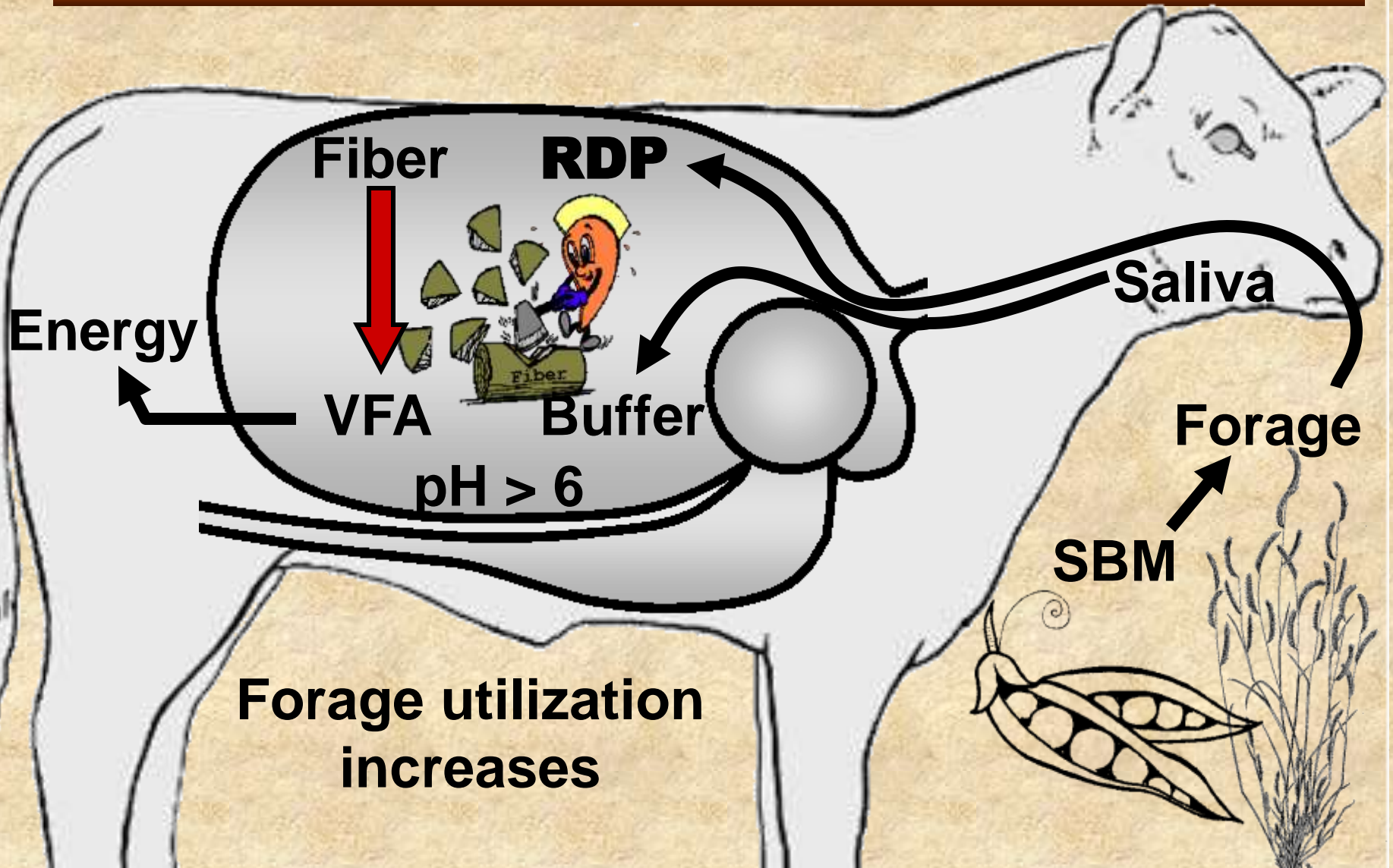
RUP for Forage Diets



High Quality Forage Diets

- Forages with RDP:RUP imbalance
- Supplementing RUP:
 - May increase:
 - Supply of metabolizable protein
 - Quality of metabolizable protein
 - Compliments microbial protein
 - Protein utilization by the animal for production may improve

RDP for Forage Diets



Low Quality Forage Diets

- Forages deficient in protein
- Supplementing RDP or NPN:
 - Increases microbial synthesis
 - Fiber-digesters are more active
 - Increases:
 - Forage digestibility (energy)
 - Forage intake
 - Positive Associative Effect



Summary

- High quality forages/pasture:
 - Protein is in excess, and energy is more limiting
 - Supplementing an energy source can make ruminant animals utilize the forage protein more effectively
 - Grain may decrease forage use
 - Digestible fiber sources

Summary

- **High quality forages/pasture:**
 - **Protein is in excess, but there may be a RDP:RUP imbalance**
 - **Supplementing protein sources high in RUP may improve metabolizable protein utilization**
 - **RUP sources: Corn gluten feed, wheat midds, distillers grains**

Summary

- Low quality forages/pasture:
 - Protein is limiting, and energy is “tied up” in the forage as fiber
 - Supplementing a protein source can make ruminant animals utilize the forage fiber more effectively
 - Ruminally degradable proteins sources are more effective

Conclusion

- **Good nutritional management:**
 - **Identify limiting nutrients**
- **Decision:**
 - **Accept limitation?**
 - **Correct limitation?**
- **Will the production improvements cover the expense required to correct the limitation?**



Nutrient Composition



Carbohydrate?
Protein?
Minerals?
Other?

Forage Nutrient Analysis

- **Good tool to identify limiting nutrients**
- **Pasture sampling for analysis is difficult, because:**
 - **Difficult to predict what grazing animals will select**
 - **Generally select plants that are higher in nutrients than the average forage in the pasture**

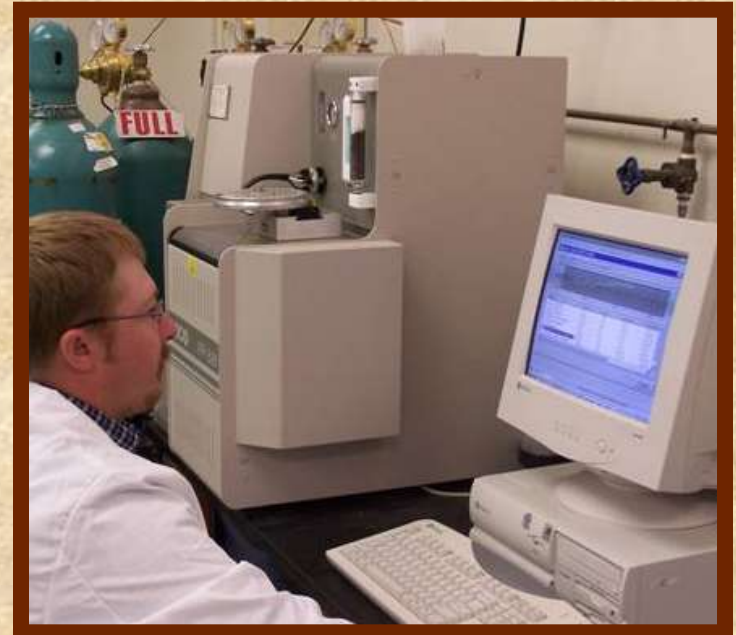
Dry Matter (DM)

- **Moisture-free portion of feed**
 - **Feed is dried in an oven**
- **DM analysis is very useful:**
 - **Moisture content has a large affect on concentrations of other nutrients in the feed**



Crude Protein (CP)

- **Measure of:**
 - **True protein + non-protein nitrogen**
- **Total nitrogen content analysis:**
 - **$\% N \times 6.25 = \% CP$**
- **Does not distinguish:**
 - **True protein vs NPN**
 - **Degradability**



Crude Protein (CP)

- **CP analysis is useful:**
 - **Large impact on forage utilization and animal production**
 - **Most expensive nutrient**
 - **Environmental pollution**



Fiber

- **Several analytical methods exist:**
 - **Crude Fiber**
 - **Neutral Detergent Fiber**
 - **Acid Detergent Fiber**



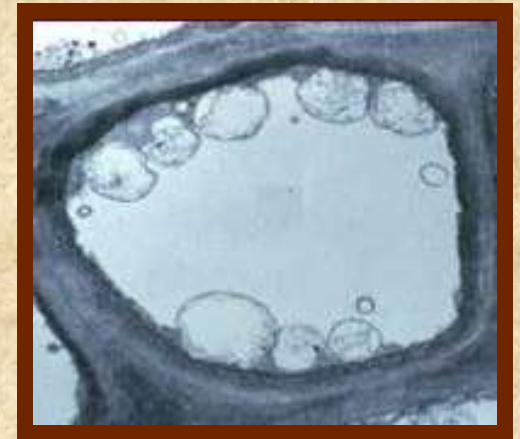
Crude Fiber

- Common on feed tags
- Analytical procedure does not provide a true measure of fiber
 - Nutritional relevance is questionable

GUARANTEED ANALYSIS	
CRUDE PROTEIN	MIN 20.00%
CRUDE FAT	MIN 2.50%
CRUDE FIBER	MAX 10.00%
CALCIUM	MIN 0.75%
CALCIUM	MAX 1.25%
PHOSPHORUS	MIN 0.55%
SALT	MIN 0.40%
SALT	MAX 0.90%
SELENIUM	MIN 0.30 PPM
VITAMIN A	MIN 2,000.00 IU/LB

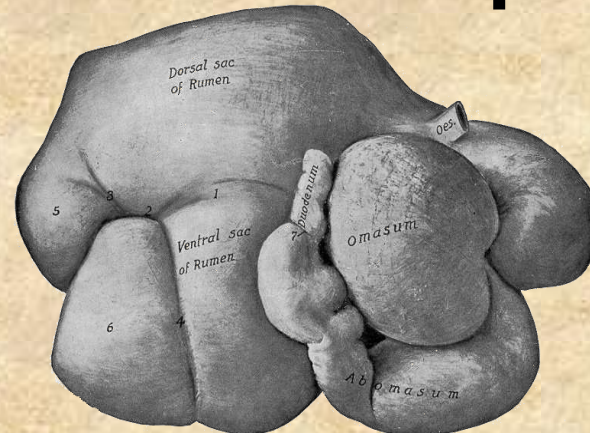
Neutral Detergent Fiber

- Measures structural (plant cell wall) portion of feeds:
 - Insoluble in neutral detergent
 - Hemicellulose
 - Cellulose
 - Lignin
- NDF is recognized as the method to measure total fiber of feedstuffs



Neutral Detergent Fiber

- NDF is very useful:
 - Related to “fill effect”
 - Used to estimate feed intake
 - Related to chewing activity
 - Effective NDF used to predict rumen pH



Acid Detergent Fiber

- **Measures less digestible fiber:**
 - **Fraction insoluble in acid detergent**
 - **Cellulose**
 - **Lignin**
- **ADF is useful:**
 - **Related to digestibility**
 - **Predict TDN**



Total Digestible Nutrients

- Represents the relative digestible energy of feeds
- TDN is calculated, not analyzed:
 - Sum of digestible nutrients
 - Calculated from ADF

Nutrient	Fraction (%)	Digestion coefficient	Digestible nutrients (%)
Ash	7	-	-
Crude Protein	14	x 0.60	= 8.4
Crude Fiber	38	x 0.45	= 17.1
Ether Extract	1	x 0.70 (x2.25)	= 1.5
NFE	40	x 0.70	= 28.0
	100		TDN = 55.0%